

## CLAIMS

### I Claim:

1. A biosolids treatment system comprising:
  - (a) a storage tank for containing a quantity of biosolids sludge;
  - (b) a system of disinfection piping, said system of disinfection piping comprised of inner biosolids piping concentrically arranged with outer steam piping, said inner biosolids piping having a plurality of holes arranged at a desired spacing around its perimeter;
  - (c) first biosolids pump means for delivering a quantity of biosolids to said storage tank for disinfection;
  - (d) second biosolids pump means for delivering a flow of biosolids from said storage tank to said inner biosolids piping;
  - (e) steam pump means for delivering a flow of steam to said outer steam piping and thereby injecting a flow of steam from said outer steam piping into said inner biosolids piping through said holes in said inner biosolids piping; and
  - (f) control means for continuously and simultaneously operating said first and second biosolids pump means and said steam pump over a predetermined period of time for circulating a flow of biosolids through said inner biosolids piping simultaneously with a flow of steam through said outer steam piping performing.
2. The biosolids treatment system as recited in claim 1 wherein said system of

disinfection piping is positioned within said storage tank.

3. The biosolids treatment system as recited in claim 1 wherein said control means includes means for determining the temperature of said flow of biosolids at desired points along said system of disinfection piping and delivering said determined temperatures to said control means.

4. The biosolids treatment system as recited in claim 3 wherein said control means includes means for determining the temperature and pressure of said flow of steam at desired points along said system of disinfection piping and delivering said determined temperatures and pressures to said control means.

5. The biosolids treatment system as recited in claim 4 wherein said plurality of holes arranged around the perimeter of said inner biosolids piping are arranged so as to form a spiral of holes around said inner biosolids piping.

6. The biosolids treatment system as recited in claim 5 wherein said spiral of holes around said inner biosolids piping are arranged with respect to the centerline of said inner biosolids pipe at an angle between about 22.5 degrees to about 60 degrees.

7. The biosolids treatment system as recited in claim 6 wherein said inner biosolids piping is between about 3 inches to about 10 inches in diameter.

8. The biosolids treatment system as recited in claim 7 wherein the lateral spacing between said holes in said inner biosolids piping is between about 3 inches to about 5 inches.

9. The biosolids treatment system as recited in claim 5 wherein said holes in said inner biosolids piping are tapered.

10. The biosolids treatment system as recited in claim 8 wherein said holes in said inner biosolids piping are tapered.

11. A biosolids treatment system comprising:

- (a) a storage tank for containing a quantity of biosolids sludge;
- (b) a system of disinfection piping, said system of disinfection piping comprised of a segment of inner biosolids piping concentrically arranged with a segment of outer steam piping, said segment of inner biosolids piping having a plurality of holes spirally arranged at a desired spacing around its perimeter, said system of disinfection piping being positioned within said storage tank;
- (c) first biosolids pump means for delivering a quantity of biosolids to said storage tank for disinfection;
- (d) second biosolids pump means for delivering a flow of biosolids from said storage tank to said segment of inner biosolids piping; and

- (e) steam pump means for delivering a flow of steam to said segment of outer steam piping and thereby injecting a flow of steam from said outer steam piping into said inner biosolids piping through said holes in said inner biosolids piping.

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12. The biosolids treatment system as recited in claim 11 further comprising computerized control means for continuously and simultaneously monitoring said flow of biosolids and controlling said first and second biosolids pump means and said steam pump means for circulating a flow of biosolids through said inner biosolids piping simultaneously with a flow of steam through said outer steam piping over a predetermined period of time and at predetermined temperature ranges.

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13. The biosolids treatment system as recited in claim 12 wherein said control means includes means for determining the temperature of said flow of biosolids at desired points along said system of disinfection piping.

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14. The biosolids treatment system as recited in claim 13 wherein said control means includes means for determining the temperature and pressure of said flow of steam at desired points along said system of disinfection piping.

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15. The biosolids treatment system as recited in claim 14 wherein said segment of inner biosolids piping includes a plurality of rotatably mounted Archimedes spiral screws positioned within bore of said inner biosolids piping at desired locations.

16. The biosolids treatment system as recited in claim 15 wherein said holes in said inner biosolids piping are tapered.

5 17. A method of treating wastewater containing a quantity of biosolids comprising:

- (a) providing a biosolids storage tank;
- (b) providing a system of disinfection piping positioned within said storage tank, said system of disinfection piping having a segment of inner biosolids piping concentrically arranged with a segment of outer steam piping, said segment of inner biosolids piping having a plurality of holes spirally arranged at a desired spacing around its perimeter;
- (c) providing a first biosolids pump means for delivering a flow of biosolids to said storage tank;
- (d) providing a second biosolids pump means for delivering a flow of biosolids from said storage tank to said segment of inner biosolids piping;
- (e) providing a means for generating a quantity of steam;
- (f) providing steam pump means for delivering a quantity steam from said means for generating a quantity of steam to said outer steam piping and then to said inner biosolids piping through said holes in said inner biosolids piping so as to heat and spirally rotate said flow of biosolids in said biosolids piping;
- (g) providing piping means to return steam recovered from said outer steam piping to said means for generating a flow of steam;

- (h) returning steam recovered from said outer steam piping to said means for generating a flow of steam providing piping means;
- (i) providing piping means for receiving biosolids from said inner piping system; and
- (j) receiving biosolids from said inner piping system and delivering said received biosolids to a desired location.

18. The method of treating wastewater containing a quantity of biosolids as recited in claim 17 further comprising the steps of:

- (a) providing control means for said ;
- (b) providing monitor means for measuring the temperature and flow rate of said flow of biosolids in said inner biosolids piping and the temperature, pressure and flow rate of said flow of steam in said outer steam piping at desired locations along said segment of inner biosolids piping and for generating signals of the temperatures, pressures and flow rates so measured;
- (c) providing means for delivering said temperature, pressure and flow rate signals to said control means for generating control signals; and
- (d) delivering said control signals to said first and second biosolids pump means and said steam pump means for regulating the temperature, pressure and flow rate of said flow of steam in said outer steam piping and said flow of biosolids in said inner biosolids piping.

19. The method of treating wastewater containing a quantity of biosolids as recited in claim 18 wherein said step of delivering said received biosolids to a desired location includes delivering said biosolids to a land farm.

5 20. The biosolids treatment system as recited in claim 19 wherein the step of providing a system of disinfection piping includes providing a plurality of rotatably mounted Archimedes spiral screws positioned within bore of said inner biosolids piping at desired locations.

10 21. The method of treating wastewater containing a quantity of biosolids as recited in claim 19 wherein said biosolids are generated from municipal sewage.

22. The method of treating wastewater containing a quantity of biosolids as recited in claim 19 wherein said holes in said inner biosolids piping are tapered.

15 23. The method of treating wastewater containing a quantity of biosolids as recited in claim 22 wherein said tapered holes have a diameter at the outer surface of said biosolids piping of about 1.5 to about 3 times greater than the diameter of said holes at the inner surface of said biosolids piping.

20 24. The method of treating wastewater containing a quantity of biosolids as recited in claim 18 wherein said step of delivering said received biosolids to a desired location

includes delivering said received biosolids to a VOC extraction unit for removal of any volatile gases that might be contained in the disinfected solids.

5 25. The method of treating wastewater containing a quantity of biosolids as recited in claim 24 further comprises the step of delivering said biosolids to a centrifuge for further dewatering.

10 26. The method of treating wastewater containing a quantity of biosolids as recited in claim 17 wherein said step of providing a system of disinfection piping positioned within said storage tank includes providing said piping system configured in a coil.

15 27. The biosolids treatment system as recited in claim 2 wherein said system of disinfection piping is configured in a coil.

20 28. The biosolids treatment system as recited in claim 10 wherein said system of disinfection piping is configured in a coil.

29. The biosolids treatment system as recited in claim 28 wherein said inner biosolids piping includes a plurality of rotatably mounted Archimedes spiral screws positioned within the bore of said inner biosolids piping at desired locations.

30. The biosolids treatment system as recited in claim 11 wherein said system of disinfection piping is configured in a coil.



31. The biosolids treatment system as recited in claim 14 wherein said holes in said inner biosolids piping are tapered so that said holes have a diameter at the outer surface of said biosolids piping of about 1.5 to about 3 times greater than the diameter of said holes at the inner surface of said biosolids piping.